

**ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM**

Technical Memorandum

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Small Arms Range Characterization

Purpose: As the Military Munitions Response Program (MMRP) Site Investigation (SI) process advances ADEC will be required to provide guidance to Department of Defense (DoD) on the appropriate strategy to characterize the extent and magnitude of lead contamination at former DoD small arms ranges (SAR). This document provides guidance on field screening, sample collection, and laboratory analysis of soil samples to characterize these sites. To characterize a SAR, ADEC recommends using a combination of X-Ray Fluorescent (XRF) field screening and laboratory analysis for lead, with a limited number of samples also analyzed for antimony, arsenic, copper and zinc.

Field Screening: ADEC recommends using X-Ray Fluorescence (XRF) for field screening of lead concentrations at former SAR. Methodologies for using handheld XRF instruments include In-Situ and Ex-Situ sampling.

- **In-Situ XRF sampling,** soil at the sample location is prepared for analysis in place. Vegetative matter, rocks and other debris is removed from the sample location and the soil is broken up and homogenized prior to analysis. If metal debris, bullets, or bullet fragments are observed they should be removed and it should be noted on the sample collection form. The XRF instrument is placed directly on the homogenized soil and a measurement is taken.
- **Ex-Situ Sampling,** soil is removed from the sample location and placed in a container for additional processing similar to above. Typically the sample is taken to a fixed base for processing and analysis. An effort should be made to remove bullets and/or bullet fragments from the sample prior to analysis. However, the mass of the entire sample should be measured and the mass of any bullets/fragments removed should also be measured and recorded on the sample collection form. The prepared soil is placed in a sample cup (or other appropriate container) and a measurement is taken with the instrument. Ex-situ procedures need to be described in detail in the work plan and should be submitted to ADEC for review and approval.

In-situ XRF sampling should be conducted to refine the location of the impact berm and/or firing line if these features are not readily identifiable. Once these features have been identified Ex-Situ XRF sampling should be conducted to determine the extent and magnitude of metals contamination.

Sampling Strategy-Impact Berm: Three or four transects should be delineated across the face of the impact berm. Points along transects (spaced at even intervals, approximately 5-10 feet) should be selected as sampling points. The number of transects and points will be largely determined based on the size of the impact berm and should be specified in the work plan. Three samples for Ex-Situ analysis should be collected at each point at different depth intervals. In-Situ XRF screening and visual observation should be used to determine the depth of affect within the impact berm. Typically bullets come to rest within the first two feet of the berm but this varies depending on the soil types, firearms, and ammunition used. The depth of affect should be divided into three equal sampling intervals.

Sampling Strategy-Range Floor: The Range Floor is defined as the area between the firing line and the primary impact berm. The Range Floor receives particulates resulting from the muzzle blast and lead dust resulting from rifled barrels that cut into the projectile as it leaves the barrel. Contaminants in this area are typically shallow, less than 6 inches below ground surface (bgs). Therefore to characterize this area of the range a grid should be extended from the primary impact berm to the firing line and extending 10 feet behind the firing line. Grid spacing will largely be determined by the size of the range. Grid spacing and sample density should be specified in the work plan. XRF surface soil samples (0 to 6 inches bgs) should be collected at grid points on the range floor.

Laboratory Analysis: ADEC recommends submitting 20 soil samples for laboratory analysis of lead to create a correlation curve demonstrating the accuracy of XRF, and analyzing 2 or 3 samples from areas that have the highest field screening results for antimony, arsenic, copper and zinc. Samples submitted for laboratory analysis should be air dried, sieved, and then ground to reduce the potential heterogeneity of the sample. The mass of any bullets or bullet fragments removed from the sample should be quantified similar to Ex-Situ XRF field screening. Samples with a broad range of lead concentrations should be submitted for laboratory analysis to ensure a good spread of data for calculating the correlation curve.

Where In-Situ XRF screening will be used to support a site management determination laboratory analysis of soil samples and a correlation curve will be required to confirm the accuracy of the XRF screening.

Note: While the sample number may seem excessive the cost per individual analysis should not be prohibitive (approximately \$45 per sample).

Additional Recommendations: Many of the SARs being investigated under the MMRP SI program in Alaska are remote and isolated. Therefore, to facilitate remedial action decisions that may be required for these sites in the future ADEC recommends the following additional samples be collected:

- A Bulk Sample of the most contaminated area of the impact berm should be collected to determine of bulk lead content of the soil and for conducting any treatability assessment that may be required prior to selecting a remedy.
- TCLP samples should also be collected to determine if land disposal of lead contaminated soils in a local landfill is appropriate.

Nearby surface waters or wetlands that could be directly affected by firing or may be receiving runoff from the areas of the ranges where shot or bullets are deposited should also be noted. Procedures for investigating any such area should be described in detail in the work plan submitted to ADEC for review and approval.

Safety Considerations: While SARs were primarily used for small arms training the possibility exists that other munitions and explosives of concern (MEC) may be present within the range. Ordnance such as 40mm projectile grenades, 2.36-inch rockets, and rifle grenades may have been used incidentally at these ranges. Site reconnaissance by UXO qualified personnel should be conducted prior to SAR characterization.